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The Effect of Whey Protein Supplementation on Exercise-Induced Muscle Damage

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ABSTRACT

Objective: *This study aimed to determine the exercise-induced muscle damage responses to whey protein supplementation in soccer players.* ***Methods:*** *Total 22 male soccer's participated in this study. Subjects were divided into 2 groups as experiment group (n=11) and placebo group (n=11). Blood samples were taken from the athletes' basal, post-exercise (PE), 2 hours after supplement ingestion (PS). Serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), creatine kinase (CK) and total protein values were analyzed.* ***Results:*** *A statistically significant difference was found when PE total protein was compared to basal and PS in the experiment (whey) and placebo group ($p<0.05$). Basal serum LDH level was significantly lower than PE and PS values in the whey group ($p<0.05$).* ***Conclusions:*** *It was observed that whey protein consumed after exercise did not have any positive effect on athletes' muscle damage values which are directly affecting the recovery such as total protein, ALT, AST, LDH, and CK.*

Keywords: Whey protein, Muscle damage, Performance, Recovery, Soccer

INTRODUCTION

The effect of nutrients on athletes' health and performance is one of the topics studied frequently. Milk, one of these nutrients, is defined as a functional nutrient and its consumption has a direct and measurable effect on athletes' health and performance [1]. Milk contains two main protein groups; casein and whey proteins. The ratio of casein in milk is almost 80% and makes up the majority of the protein. Whey ratio is calculated as 20% [2].

Whey protein is a protein complex that contains a number of basic amino acids and is the fastest protein that gets into the blood. A popular supplement, whey, has general health benefits in the number of processes and systems such as bone, muscle, blood, brain, pancreas, immune, cancer, infection, metabolism, wound healing, learning and aging [3]. It is frequently used especially by athletes since it improves performance and development. Some of the most known benefits for sportive performance are; muscle hypertrophy, accelerating the protection and recovery of muscles, preventing muscle damage by providing muscle protein synthesis, elevating anabolic hormone levels and suppressing catabolic hormones, inhibiting oxidative stress, and providing ideal body composition [1,2]. Whey protein is one of the known highest quality protein supplements on the athletes' diet and is preferred as a post-training supplement [4].

Muscle damage occurs in the soccer by sudden accelerations and decelerations, explosive jumps, eccentric loads or related traumas. A large number of intense training and competitions may negatively affect the performance of the following training in terms of skeletal muscle, nerves, and immune system, especially if minimal recovery time is present. This situation is observed especially in the tight fixture period, within the short-term framework that requires competition and loadings over and over again (non-stop). For this reason, recovery capacity after intensive training and competition is considered to be an important predictor for the following training session [5].

The muscular damage is described as a condition which results in exhaustion, fatigue, loss of power and pain after heavy exercises [6]. The cellular damage occurs on the intensity and the type of exercise. This is termed as microtrauma, micro-injury or muscular damage in the literature [7]. Different types of exercises create pain at different levels and they have different effects on the muscular damage [8]. Strenuous and unaccustomed exercise can induce skeletal muscle damage and this is particularly true of exercise including eccentric contraction [9]. Although the muscular damage is related to the intensity of the exercise, unfamiliar exercises can cause muscular damage frequently [10].

The aim of this study was to investigate the effect of acute whey protein consumption after the exercise on biochemical responses and muscle damage.

PATIENTS AND METHODS

Research Group

In this study, 22 volunteers, in shape, male soccer's between the ages of 18-22 years, participated in this study. Subjects were divided into two groups as experiment group (whey) (n=11) and placebo group (n=11). In subjects, requirements of being healthy, not having the chronic or acute disease and not having any movement limitation depending on disability occurred for any reason were looked for. For this study, by the University Human Research Ethics Board it was decided that there was no inconvenience ethically and it was found appropriate (Number: 57452775-604.01.02-E.).

Exercise Protocol

Subjects performed a graded exercise test commencing at 60 W to create exhaustion on, followed by 35 W increments every 3 min on the ergometer. The exercise was ended when the heart rate reached the peak level, RER exceeded 1.1 values or subject didn't achieve 60 rpm [11,12].

Study Design

In the study, firstly some biochemical blood parameters were analyzed by taking basal blood samples prior to exercise and supplementation. Later ergometer was applied to athletes and right after the exercise done until exhaustion venous blood was again taken from the athletes for tests and then beverage was given to the whey and placebo groups (whey protein and water). After athletes consumed the drinks given to them under the supervision of researchers and in allotted time venous blood was taken for the last time for biochemical blood analysis two hours after consumption and some biochemical parameters of athletes were analyzed after acute whey protein supplementation. Measurements and tests were made at the same physical conditions in both the whey and placebo groups.

Blood Measurements

Venous blood was taken from the subjects by expert nurses for biochemical tests and analyzed by biochemistry specialists. Biochemistry analysis was studied from the serum samples acquired by 3500 cycle/minute and 15-minute centrifuge speed of venous blood at Abbott Architect c16000 biochemistry autoanalyzer. The upper phases were transferred to Eppendorf tubes and kept at -80°C until the use. About 3 different 15 cc venous blood samples were taken from the athletes' basal, post-exercise (PE), 2 hours after supplement ingestion (PS). Total protein, serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH) and creatine kinase (CK) values were analyzed.

Supplementation

Immediately after exercise 22 soccers' were randomly divided into two groups as whey (n=11) and placebo (n=11) group. The study was conducted as a single-blinded application. Whey protein supplement was given to the experimental group in accordance with the administration and daily dosage (with 300 ml water), an equal amount of placebo (water) to the given nutritional supplement was given to the placebo group. The supplementation was prepared beforehand and as a single dose that includes whey protein 30 g. The athletes were not informed about the substance given to them. So the psychological effects that may occur in athletes were removed and the study was conducted in more reliable conditions. In addition, the athletes were warned about not consuming any alcohol and stimulants one day before the test, caring for the nutrition and resting.

Statistical Analysis

The research data obtained were given in the form of the mean ± standard deviation (Mean ± SD) and standard error of the mean (Mean ± SEM). The normality of the distribution was tested using the Kolmogorov-Smirnov test. The Mann-Whitney U-test was used to compare basal, PE, PS values between the two groups. Friedman's ANOVA was used to compare the serum total protein, ALT, AST, LDH and CK levels during the 3 study time-points. If required, a post-hoc test was applied to detect the source of the differences. Statistical significance was accepted as $p<0.05$. In the making of statistical analysis derived from the study and comparing the results, SPSS version 22 package program was used.

RESULTS

A statistically significant difference was found when PE total protein was compared to basal and PS in the whey and placebo group ($p<0.05$) (Figure 1). There was no statistically significant difference between the groups ($p>0.05$) (Table 1). All of the serum ALT levels were similar for both groups ($p>0.05$) (Figure 2, Table 1).

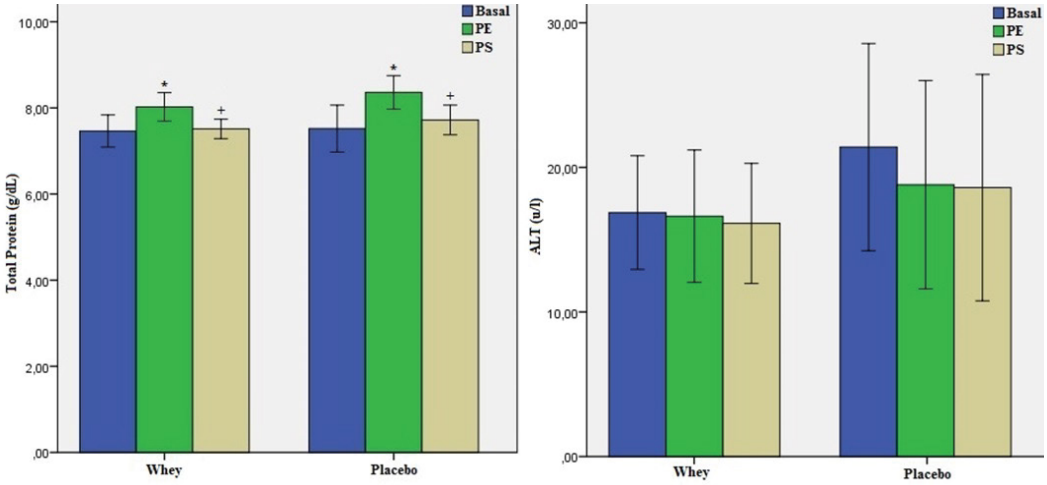

Figure 1 Changes in the serum ALT (U/L) and total protein (g/dL); *Significant difference compared with basal ($p<0.05$). $^{+}$Significant difference compared with post-exercise ($p<0.05$); $^{\#}$Significant difference between whey and placebo groups ($p<0.05$) (M ± SEM)

Table 1 Changes in mean values of whey and placebo groups (M ± SD)

Variable	Whey			Placebo		
	Basal	PE	PS	Basal	PE	PS
T. Protein (g/dL)	7.46 ± 0.44	8.02 ± 0.39*	7.51 ± 0.26^{+}	7.52 ± 0.43	8.36 ± 0.31*	7.72 ± 0.27^{+}
ALT (U/L)	16.87 ± 4.70	16.62 ± 5.47	16.12 ± 4.96	21.40 ± 5.77	18.80 ± 5.80	18.60 ± 6.30
AST (U/L)	17.87 ± 3.56	18.25 ± 4.30	17.87 ± 3.04	34.80 ± 21.92$^{\#}$	27.00 ± 5.43$^{\#}$	26.40 ± 5.85$^{\#}$
LDH (U/L)	157.62 ± 28.22	195.37 ± 32.16*	193.62 ± 30.88*	192.00 ± 21.54$^{\#}$	211.60 ± 29.08*	202.20 ± 26.22
CK (U/L)	124.00 ± 40.64	254.12 ± 248.52	245.37 ± 220.24	776.60 ± 1232.76	530.40 ± 666.08	557.40 ± 717.48

*Significant difference compared with basal; $^{+}$Significant difference compared with post-exercise; $^{\#}$Significant difference between whey and placebo groups

Although the AST levels were similar between the groups ($p<0.05$), there was no significant difference intra-group comparison for the placebo and whey groups ($p>0.05$) (Figure 2, Table 1).

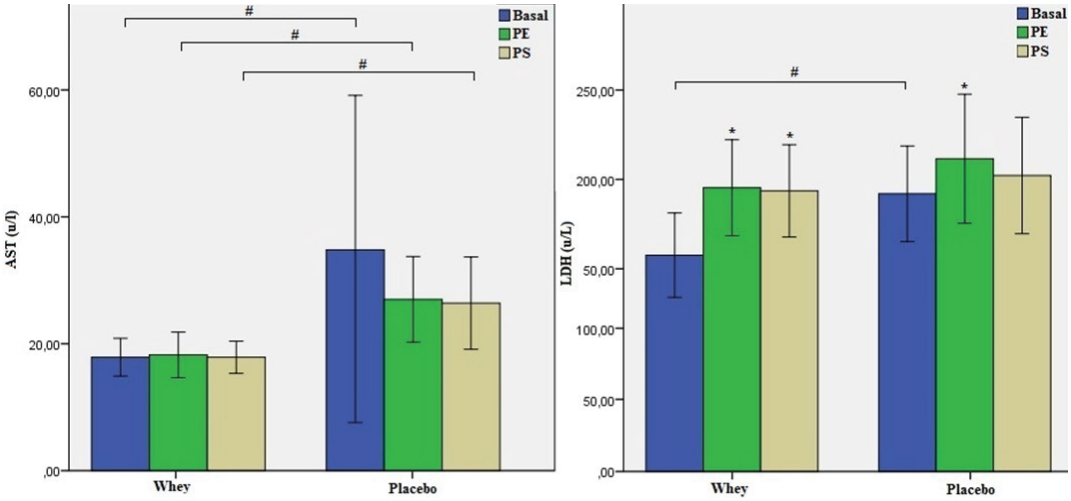

Figure 2 Changes in the serum AST and LDH (U/L); *Significant difference compared with basal ($p<0.05$); $^{+}$Significant difference compared with post-exercise ($p<0.05$); $^{\#}$Significant difference between whey and placebo groups ($p<0.05$) (M ± SEM)

Basal serum LDH level was significantly lower than PE and PS values in the whey group ($p<0.05$) (Figure 2). PE serum LDH level was significantly higher than the basal value in the placebo group ($p<0.05$). All of the LDH levels were similar between the groups ($p>0.05$), except that it was founded significantly different for basal LDH values ($p<0.05$) (Table 1).

All of the serum CK levels were similar for both groups ($p>0.05$) (Figure 3, Table 1).

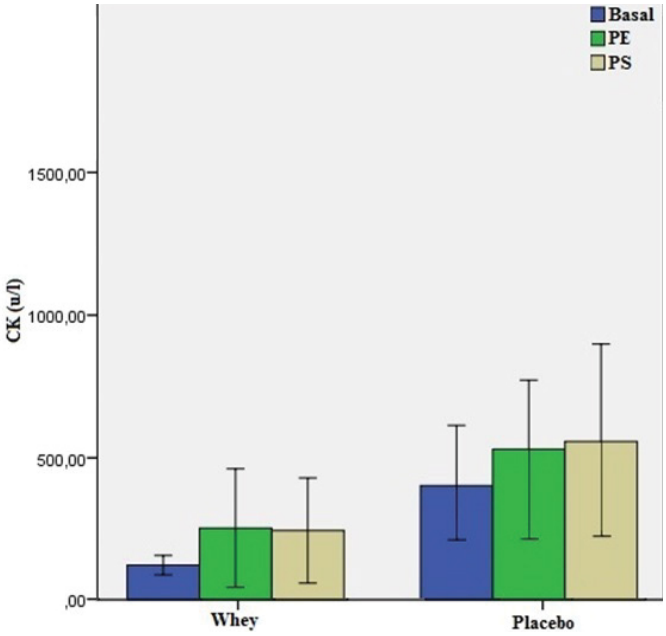

Figure 3 Changes in the serum CK (U/L); *Significant difference compared with basal ($p<0.05$); $^{+}$Significant difference compared with post-exercise ($p<0.05$); $^{\#}$Significant difference between whey and placebo groups ($p<0.05$) (M ± SEM)

DISCUSSION

The skeleton is undoubtedly the main contributor in maintaining the necessary pace during the extended and intensive activities and plays an important role in many metabolic activities during training and competition. As a result of this severe mobility, damage in active muscle fibers is inevitable. Changing this trend, which is negative for the performance, is due to the protein intake of the metabolism immediately after the exercise for muscle repair, regeneration, and recovery.

There are many different studies present in the literature on acute whey protein supplementation on resting state and pre/post-exercise state, and also a number of studies relate acute or chronic whey protein consumption to various performance evaluations such as muscle performance, muscle strength, muscle damage, endurance performance, hormone levels, and body composition [13-22].

When we look at some studies in this context, Tipton, et al., in 2004, found that after the endurance exercise, acute whey and casein protein loading increased the total muscle protein balance and this was evaluated as total muscle protein synthesis [23]. Tang, et al., in 2007, also performed acute loading in endurance exercise and used carbohydrates with whey protein. The study concluded that consumption of whey and carbohydrate after exercise could trigger muscle protein synthesis, support total protein balance and eventually cause hypertrophy [24]. In this study, the total protein levels of the subjects were examined and similar results were obtained in both the whey group and the placebo group. Therefore, the research revealed that the acute whey consumption did not cause any change in total protein amount.

Many studies claim that the use of whey protein increases muscle hypertrophy before, after, or during exercise. Some studies, additionally, report that the whey protein consumption may improve recovery after heavy exercise and may also reduce muscle damage and pain [25]. In the study by Cooke, et al., in 2010, the test group was given whey protein/carbohydrate and the control group was given carbohydrates for 14 days and the levels of plasma CK and LDH was evaluated, and consequently whey protein group showed a significant increase in the power in recovery period and a significant decrease in LDH level [19]. Buckley, et al., in 2008, analyzed the effect of whey protein on eccentric

exercise and as a result, they showed that whey consumption had no effect on CK levels [26]. It has been found that whey protein consumption may have a positive effect on LDH, CK, ALT and AST levels [27]. Chen, et al., studied the effect of whey protein on exercise performance and biochemical profiles on trained mice. Researchers, who analyzed many parameters in their work, also assessed parameters such as total protein, LDH, CK, ALT and AST as in our study. Furthermore, in the research, a significant decrease in LDH, AST and CK serum levels and a significant increase in total protein levels as a result of whey protein loading were found. In the group who did not consume whey protein, the researchers found opposite results to the consuming group as total protein levels showed a significant decrease, while LDH, CK, ALT and AST levels showed a significant increase. In addition, researchers have reported that whey protein supplements have positive effects on physical performance, other metabolic/biochemical findings as well as on total protein, LDH, AST and CK levels, which are similar parameters with our study [28]. When we look at the study, ALT, AST, LDH and CK levels of the subjects were examined and similar results were found in the in-group comparisons between the whey group and the placebo group. As a result of our work, no effect on ALT, AST, LDH and CK levels could be detected in acute whey supplementation.

CONCLUSION

According to the findings, it was observed that whey protein consumed after exercise did not have any positive effect on athletes' muscle damage values which are directly affecting the recovery such as total protein, ALT, AST, LDH, and CK, therefore it was concluded that whey protein consumption does not have an acute effect on muscle damage caused by exercise. The study results are considered to be important in terms of both the method used and the functional and alternative consumption of whey protein which can be used in athletes' nutrition. In the future studies, since time is a very important determinant in recovery, muscle damage analyses after 12-24 hours of exercise and supplementation may lead to different results. Likewise, a controlled lifestyle of the athletes, a regular diet program, examination of different functional responses and biochemical changes in the muscles, and a chronic supplementation may reveal clearer information.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Keri Marshall, N. D. "Therapeutic applications of whey protein." *Alternative Medicine Review,* Vol. 9, No. 2, 2004, pp. 136-56.

[2] Pal, Sebely, Vanessa Ellis, and Satvinder Dhaliwal. "Effects of whey protein isolate on body composition, lipids, insulin and glucose in overweight and obese individuals." *British Journal of Nutrition,* Vol. 104, No. 5, 2010, pp. 716-23.

[3] Krissansen, Geoffrey W. "Emerging health properties of whey proteins and their clinical implications." *Journal of the American College of Nutrition,* Vol. 26, No. 6, 2007, pp. 713-23.

[4] Levers, Kyle, and Kelley Vargo. "Building Muscle Mass: Physiology, Nutrition, and Supplementation." *Nutritional Supplements in Sports and Exercise*. Springer, Cham, 2015, pp. 123-57.

[5] Rey, Ezequiel, et al. "The effect of immediate post-training active and passive recovery interventions on anaerobic performance and lower limb flexibility in professional soccer players." *Journal of Human Kinetics,* Vol. 31, 2012, pp. 121-29.

[6] Burke, Ed. *Precision heart rate training,* Human Kinetics, 1998.

[7] Smith, L. L., and M. P. Miles. "Exercise Induce Muscle Injury and Inflammation." *Exercise and Sports Science*, 2000, pp. 401-10.

[8] Brown, S., S. Day, and A. Donnelly. "Indirect evidence of human skeletal muscle damage and collagen breakdown after eccentric muscle actions." *Journal of Sports Sciences,* Vol. 17, No. 5, 1999, pp. 397-402.

[9] Nonaka, Koji, et al. "Cool Water Immersion after Downhill Running Suppresses Exercise-induced Muscle Damage in the Rat Soleus Muscle." *Journal of Physical Therapy Science*, Vol. 24, No. 7, 2012, pp. 613-16.

[10] Borg, Gunnar A. "Psychophysical bases of perceived exertion." *Medicine & Science in Sports and Exercise,* Vol. 14, No. 5, 1982, pp. 377-81.

[11] Nordby, P., B. Saltin, and J. W. Helge. "Whole□body fat oxidation determined by graded exercise and indirect calorimetry: a role for muscle oxidative capacity?." *Scandinavian Journal of Medicine and Science in Sports,* Vol. 16, No. 3, 2006, pp. 209-14.

[12] İpekoğlu, Gökhan, and Şükrü Serdar Balcı. "Comparison between continuous and intermittent submaximal exercise at the intensity of maximal fat oxidation." *Journal of Human Sciences,* Vol. 13, No. 3, 2016, pp. 4604-12.

[13] Witard, Oliver C., et al. "Myofibrillar muscle protein synthesis rates subsequent to a meal in response to increasing doses of whey protein at rest and after resistance exercise." *The American Journal of Clinical Nutrition,* Vol. 99, No. 1, 2013, pp. 86-95.

[14] Tipton, Kevin D., et al. "Stimulation of net muscle protein synthesis by whey protein ingestion before and after exercise." *American Journal of Physiology-Endocrinology and Metabolism*, Vol. 292, No. 1, 2007, pp. 71-76

[15] Lands, L. C., V. L. Grey, and A. A. Smountas. "Effect of supplementation with a cysteine donor on muscular performance." *Journal of Applied Physiology,* Vol. 87, No. 4, 1999, pp. 1381-85.

[16] Cornish, Stephen M., et al. "Conjugated linoleic acid combined with creatine monohydrate and whey protein supplementation during strength training." *International Journal of Sports Nutrition and Exercise Metabolism,* Vol. 19, No. 1, 2009, pp. 79-96.

[17] Burke, Darren G., et al. "The effect of whey protein supplementation with and without creatine monohydrate combined with resistance training on lean tissue mass and muscle strength." *International Journal of Sports Nutrition and Exercise Metabolism,* Vol. 11, No. 3, 2001, pp. 349-64.

[18] Andersen, Lars L., et al. "The effect of resistance training combined with timed ingestion of protein on muscle fiber size and muscle strength." *Metabolism,* Vol. 54, No. 2, 2005, pp. 151-56.

[19] Cooke, Matthew B., et al. "Whey protein isolate attenuates strength decline after eccentrically-induced muscle damage in healthy individuals." *Journal of the International Society of Sports Nutrition,* Vol. 7, No. 1, 2010, pp. 30.

[20] Coburn, Jared W., et al. "Effects of leucine and whey protein supplementation during eight weeks of unilateral resistance training." *The Journal of Strength and Conditioning Research,* Vol. 20, No. 2, 2006, pp. 284-91.

[21] Belobrajdic, Damien P., Graeme H. McIntosh, and Julie A. Owens. "A high-whey-protein diet reduces body weight gain and alters insulin sensitivity relative to red meat in Wistar rats." *The Journal of Nutrition,* Vol. 134, No. 6, 2004, pp. 1454-58.

[22] Colker, Carlon M., et al. "Effects of supplemental protein on body composition and muscular strength in healthy athletic male adults." *Current Therapeutic Research,* Vol. 61, No. 1, 2000, pp. 19-28.

[23] Tipton, Kevin D., et al. "Ingestion of casein and whey proteins result in muscle anabolism after resistance exercise." *Medicine & Science in Sports and Exercise,* Vol. 36, No. 12, 2004, pp. 2073-81.

[24] Tang, Jason E., et al. "Minimal whey protein with carbohydrate stimulates muscle protein synthesis following resistance exercise in trained young men." *Applied Physiology, Nutrition, and Metabolism,* Vol. 32, No. 6, 2007, pp. 1132-38.

[25] Hulmi, Juha J., Christopher M. Lockwood, and Jeffrey R. Stout. "Effect of protein/essential amino acids and resistance training on skeletal muscle hypertrophy: A case for whey protein." *Nutrition and Metabolism,* Vol. 7, No. 1, 2010, p. 51.

[26] Buckley, Jonathan D., et al. "Supplementation with a whey protein hydrolysate enhances recovery of muscle force-generating capacity following eccentric exercise." *Journal of Science and Medicine in Sport,* Vol. 13, No. 1, 2010, pp. 178-81.

[27] Kume, Hisae, Keiko Okazaki, and Hajime Sasaki. "Hepatoprotective effects of whey protein on D-galactosamine-induced hepatitis and liver fibrosis in rats." *Bioscience, Biotechnology, and Biochemistry,* Vol. 70, No. 5, 2006, pp. 1281-85.

[28] Chen, Wen-Chyuan, et al. "Whey protein improves exercise performance and biochemical profiles in trained mice." *Medicine and Science in Sports and Exercise,* Vol. 46, No. 8, 2014, p. 1517.